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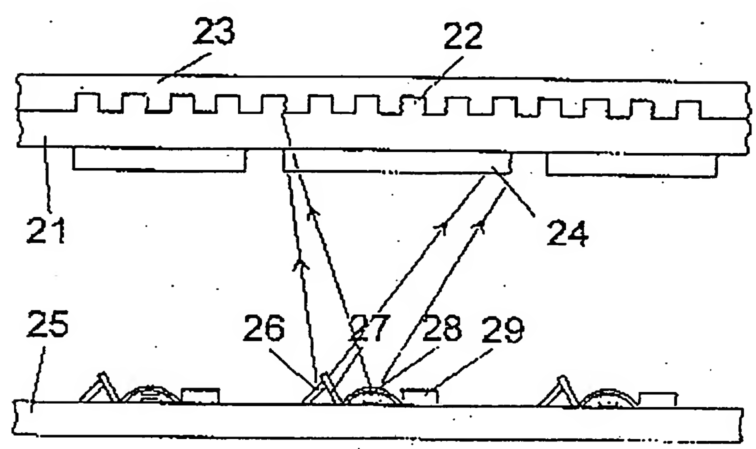
(54) **DISPOSITIF DE PRISE DE VUE**
(54) **IMAGE RECORDING SYSTEM**



(57) Dans un dispositif de prise de vue comprenant au moins un photodétecteur par pixel à enregistrer, est disposé avant le ou les photodétecteur(s) un élément de focalisation pour représenter chaque pixel sur le ou les photodétecteurs. Il est également possible d'associer ledit dispositif à un écran, notamment un écran couleur, dont une seule face est utilisée pour l'enregistrement et la reproduction.

(57) In an image recording system with at least one photodetector for each picture element to be recorded, a focusing element is provided in front of the (minimum of one) photodetector and serves to focus one picture element onto each photodetector. A combination with a screen, in particular a colour screen, is also possible, in which case a single surface serves for recording and reproduction.

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planar image to be recorded by scanning transversely to the line orientation. However, this further refinement also makes it possible, when working with an already planar, i.e., raster-type arrangement of the photodetectors and of the focusing elements, to electrically alter the viewing direction of the video imaging device.

One advantageous embodiment of the video imaging device according to the present invention provides for the structures of the focusing elements to be rotationally symmetric, the optical midpoint being disposed in the middle of the surface assigned, as the case may be, to a focusing element. This embodiment is intended, first and foremost, for recording objects situated right in front of the video imaging device. In this context, the further refinement mentioned above makes it possible to rotate the viewing direction. Another advantageous embodiment is conceived for a viewing direction that deviates therefrom, in that the focusing element has an asymmetrical construction, so that an oblique viewing direction results in response to a centrically arranged photodetector.

When working with the video imaging device according to the present invention, an image of the object parts that are not to be picked up by a photodetector is formed next to the photodetector. To ensure that the quality is not degraded by scattered light, another embodiment of the invention provides that the surfaces of a carrier base bearing the photodetector, the surfaces not being covered with photodetectors, be developed as absorbing surfaces.

One embodiment of the video imaging device according to the present invention for picking up colored images is rendered possible in that color filters of different colors are assigned to the photodetectors.

As is the case when working with other video imaging devices, the light impinging upon the photodetector can be converted into an electric signal by generating a charge corresponding to the quantity of light. Since the quantity of light for each photodetector in the case of the video imaging device according to the present invention is very small, it is preferably proposed to provide for single electron-tunnel components to read out the

VIDEO IMAGING DEVICE

Background Information

The invention relates to a video imaging device according to the definition of the species in Claim 1.

Video imaging devices having at least one photodetector per picture element to be recorded have become known as so-called CCD cameras, where a lens is arranged in front of a semiconductor sensor containing the photodetectors in a raster shape.

A device is known from German DE-A-31 40 217 for reading a master surface having image information, whereby the device moves the image information using a photosensor for imaging via a plurality of imaging systems. The known device has, however, a fixed object width, and the imaging systems are not able to change the viewing angle of the reading device.

Therefore, the object of the invention is to devise a video imaging device which will eliminate these disadvantages.

The video imaging device according to the present invention is able to record images of objects disposed oppositely to it with substantial depth of focus. If the individual photodetectors are spaced apart at the same distances (grid dimensions) as the focusing elements, then images are always formed on a scale of 1 to 1.

An advantageous method for manufacturing the video imaging device of present invention is rendered possible in a further refinement by constituting the focusing element as a refractive microlens, a refractive Fresnel microlens or a stepped plate, the focusing elements for all picture elements to be imaged being formed by structurally defining a transparent carrier base.

Provision is made in another refinement for a plurality of optionally actuatable photodetectors to be assigned in each instance to one focusing element. With the aid of a device having one or a few lines of focusing elements, this further refinement enables a

charge produced in each instance in a photodetector as a function of the light intensity. Single electron-tunnel components (SED = single electron devices) are described, for example, in A. H. Clealand, "The Detection and Manipulation of Single Electrons", Digest of Papers MicroProcess '94, 7th International MicroProcess Conference, Hsinchu, Taiwan, July 11-14, 1994, pp. 146-149.

Due to their size, however, the described components must be operated as cooled components to achieve a sufficient signal-to-interference ratio. The need for this is eliminated, however, in a further refinement of the invention, where the structures of the single electron-tunnel components are smaller than 10 nm. In this context, printed circuit traces are preferably applied lithographically to the carrier bases bearing the photodetectors for supplying voltage and for diverting the signals.

A number of applications, such as video telephones, require simultaneously recording an image to be sought and reproducing a received image. This can be achieved quite advantageously with the video imaging device according to the present invention by using a video screen, in particular a color video screen, designed for a dual function.

In one advantageous refinement of a recording and reproducing device of this kind, provision is made for a hollow space to be arranged between the carrier base forming the focusing element and the carrier base for the photodetectors, for luminescent surface elements to be applied to the inner side of the carrier base for the focusing elements, and for controllable electron sources to be configured on the carrier base for the photodetectors, each of the electron sources being assigned to a luminescent surface element.

Another advantageous refinement of a recording and reproducing device proposes that an additional carrier base for luminescent surface elements of the video screen rest on the carrier base for the focusing elements, and that an additional carrier base for the controllable electron sources be provided parallel to the carrier base for the photodetectors.

In these embodiments, it is preferable that the controllable electron sources be constituted, as the case may be, by at least one emitter tip and by extractor wires.

The emitter tips and extractor wires are preferably produced by means of corpuscular beam-induced deposition. The Patent Application P 44 16 597.8 of the applicant describes the manufacture of these picture-element radiation sources.

To prevent the photodetectors from being illuminated by the luminescent surface elements, provision can be made according to another embodiment of the invention for the electron sources and the photodetectors to be operated in time-division multiplexing mode.

Exemplary embodiments of the invention are illustrated in the drawing on the basis of several Figures and elucidated in the following description. The Figures show:

Figure 1	a section through a part of a first exemplary embodiment having a microlens;
Figure 2	a section through a part of a second exemplary embodiment having a microlens;
Figure 3	a section through a first exemplary embodiment having a Fresnel microlens;
Figure 4	a section through a second exemplary embodiment having a Fresnel microlens;
Figure 5	an application example of an image- reproducing and image-recording device according to the present invention;
Figure 6	an enlarged schematic representation of an exemplary embodiment of a

photodetector;

Figure 7 a section through a first exemplary embodiment of an image-reproducing and image-recording device; and

Figure 8 a section through a second exemplary embodiment of an image-reproducing and image-recording device.

In the video imaging device depicted in Figure 1, microlenses 2 are arranged in a raster form, with a grid element spacing d on a first carrier base 1. Situated in the focal plane of the microlenses, on a second carrier base 3, in each case opposite a microlens, are photodetectors 4, whose dimensions are set to be small, to the extent that their images on the object to be recorded (not shown) still correspond, even given the largest object width provided by the video imaging device according to the present invention, to about the size of the microlenses. Microlenses 2 are configured in a compact side-by-side arrangement, so that one microlens forms the image of one picture element of the object on a photodetector 4. The interstitial spaces between photodetectors 4 can be unassigned. Preferably, a blackening prevents a diffused reflection of the light impinging from adjacent picture elements of the object, which in turn would lead to scattered light. The arrangement can include other photodetectors 5, 6 as well, however. For example, if photodetector 5 is used in place of photodetector 4, then the video imaging device "looks" to the side in accordance with dot-dash line 7. This can follow in a statical operation - i.e., a lasting or continuing angle can be adjusted - or in an operation that changes in rapid succession, so that an image-scanning motion results.

In the exemplary embodiment according to Figure 2, microlens 2 is mounted on a prism 8, so that the video imaging device already "looks" to the side with an angle β, when photodetector 4 is disposed opposite the middle of microlens 2. In addition, the viewing angle can be changed by selecting one of photodetectors 4, 5, 6.

In the exemplary embodiments according to Figures 3 and 4, a Fresnel microlens is

provided in each case as a focusing element. In comparison to Fresnel microlens 10 shown in Figure 3, Fresnel microlens 11 in the exemplary embodiment according to Figure 4 has an asymmetrical form, so that the camera "looks to the side" with respect to a centrically arranged photodetector 4.

Figure 5 depicts an application example of a video-recording and -reproducing device according to the present invention, which is used as a flat video screen 11 on a desk 12. A person 13 using the device according to the present invention can look at the video screen. In addition, an image of the head of person 13 can be recorded and transmitted, since he or she is situated in recording area 14. Objects within recording area 14 are recorded with a constant imaging scale. When using the video imaging device of the present invention, there is no need to focus to a specific object width. A sharp image of the object is formed, for as long as it is situated in recording area 14.

In the illustration in Figure 5, the camera "looks" at an angle that deviates from 90°. When the video imaging device according to the present invention is designed accordingly, this angle can be electronically adjusted and, thus, adapted to the particular circumstances.

Figure 6 schematically depicts a photodetector, which essentially includes two conductive electrodes 15, 16, which are arranged in a vacuum 17. When a color-recording device is used, layer 18 covering the photodetector is constituted as a color filter. Electrode 15 is transparent and receives an accelerating voltage U, which amounts to a few 100 V. Arriving photons 20 penetrate electrode 15 and impinge upon electrode 16, which is designed, e.g., is provided with an alkali metal coating, to emit photoelectrons. The emerging electrons are pulled toward electrode 15 by the accelerating voltage. The voltage changes produced by the emerging electrons are suitably amplified in an amplifier 20 arranged on same carrier base 19. Printed circuit traces and circuit arrangements (not shown) effect in a generally known way a sequential sampling of the output signals from the photodetectors, so that a video signal is formed.

Suitable as amplifiers are, preferably, so-called single-electron amplifiers. Optionally, three photodetectors assigned to one basic color each can be sequentially connected to an amplifier.

Figures 7 and 8 each show schematic details of a video recording and video reproducing device, the exemplary embodiment according to Figure 7 using in each case the same carrier bases for the components of the video reproducing device as for the video recording device and, for that, separate carrier bases being provided in the exemplary embodiment according to Figure 8.

Transparent carrier base 21 in the exemplary embodiment according to Figure 7 is structurally formed on its top side with stepped plates 22 arranged in a raster shape, each having an edge length of 300 µm. In addition, transparent carrier base 21 is provided with a protective layer 23. Disposed on the inner side of carrier base 21 is - likewise in a transparent construction - per stepped plate, a surface element 24 of the video screen. Suited as luminescent material for the video screen or for its surface elements are, for example, indium tin oxide or tin oxide.

At a predefined distance thereto - for example 300 µm - is disposed carrier base 25 for the electron emitters and the photodetectors. Both are shown, substantially enlarged, in comparison to the distance between carrier bases 21, 25 and in comparison to stepped plate 22 and surface element 24. Thus, for example, the width of a photodetector, inclusive of the amplifier, is about 20 µm, while about 3 µm are provided for an electron emitter.

A suitable electron emitter is described in detail in the Patent Application P 44 16 597.8 of the applicant, inclusive of a manufacturing method with the aid of additive electron or ion-beam lithography, using corpuscular beam-induced deposition. Therefore, further clarification is not needed for an understanding of the invention. An electron emitter includes, in each case, at least one emitter wire 26 and at least one extractor wire 27, which is linked to a somewhat higher potential than emitter wire 26. The emerging

electrons are accelerated toward surface element 24 of the video screen. The brightness is able to be controlled both via the potential of extractor wires 27 as well as via the voltage being applied to surface element 24 of the video screen.

Besides the electron emitters, photodetectors 28 and amplifiers 29, as were described, for example, in connection with Figure 6, are arranged on carrier base 25. The light from the picture element in question of the object to be imaged impinging upon stepped plate 22 is focused at photodetector 28.

Due to the movement of electrons from the electron emitters to the video screen, a vacuum is required between carrier bases 21 and 25. To maintain a spacing, i.e., to resist the pressure produced by the vacuum, as is generally known, glass pearls can be inserted between carrier bases 21, 25 at positions not needed for video imaging and reproduction.

In the exemplary embodiment according to Figure 8, besides a carrier base 31, which forms the stepped plates, provision is made for a carrier base 32 for surface elements 24 of the video screen and, besides carrier base 33 for photodetectors 28, provision is made for a carrier base 34 for electron emitters 26, 27. Between carrier base 33 and carrier base 34 is a protective layer 30.

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Besides the electron emitters, photodetectors 28 and amplifiers 29, as were described, for example, in connection with Figure 6, are arranged on carrier base 25. The light from the picture element in question of the object to be imaged impinging upon stepped plate 22 is focused at photodetector 28.

Due to the movement of electrons from the electron emitters to the video screen, a vacuum is required between carrier bases 21 and 25. To maintain a spacing, i.e., to resist the pressure produced by the vacuum, as is generally known, glass pearls can be inserted between carrier bases 21, 25 at positions not needed for video imaging and reproduction.

In the exemplary embodiment according to Figure 8, besides a carrier base 31, which forms the stepped plates, provision is made for a carrier base 32 for surface elements 24 of the video screen and, besides carrier base 33 for photodetectors 28, provision is made for a carrier base 34 for electron emitters 26, 27. Between carrier base 33 and carrier base 34 is a protective layer 30.

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Deutsche Telekom AG

Revised Claims

1. A video imaging device comprising
at least one focusing element (2, 10, 11, 22) for forming an image of one picture element at a time (p. 6, 2nd para.),
characterized in that each focusing element (2, 10, 11, 22) has a plurality of photodetectors (4, 5, 6) assigned to it, the photodetectors being situated in the focal plane of the focusing element in question, so that there is no need to focus to an object width, the photodetectors (4, 5, 6) being able to be read out in a freely selectable manner to change the viewing angle of the video imaging device.

2. The video imaging device according to Claim 1,
characterized in that the focusing element is a refractive microlens (2), the focusing elements for all picture elements to be imaged being formed by structurally defining a transparent carrier base (1).

3. The video imaging device according to Claim 1,
characterized in that the focusing element is a refractive Fresnel microlens (10, 11), the focusing elements for all picture elements to be imaged being formed by structurally defining a transparent carrier base (1).

4. The video imaging device according to Claim 1,
characterized in that the focusing element is a stepped plate (22), the focusing elements for all picture elements to be imaged being formed by structurally defining a transparent carrier base (21, 31).

5. The video imaging device according to one of Claims 1 through 4, characterized in that structures of the focusing elements (2, 10, 22) are rotationally symmetric, the optical midpoint being disposed in the middle of the surface assigned, as the case may be, to a focusing element (2, 10, 22).

6. The video imaging device according to one of Claims 1 through 4, characterized in that the focusing element (11) has an asymmetrical construction, so that an oblique viewing direction results in response to a centrically arranged photodetector (4).

7. The video imaging device according to one of the preceding Claims, characterized in that the surfaces of a carrier base (3, 25, 33) bearing the photodetectors (4, 5, 6, 28), the surfaces not being covered with photodetectors (4, 5, 6, 28), are developed as absorbing surfaces.

8. The video imaging device according to one of the preceding Claims, characterized in that color filters (18) of different colors are assigned to the photodetectors (15, 17).

9. The video imaging device according to one of the preceding Claims, characterized in that provision is made for single electron-tunnel components to read out the charge produced in each instance in a photodetector as a function of the light intensity.

10. The video imaging device according to Claim 9, characterized in that the structures of the single electron-tunnel components are smaller than 10 nm.

11. The video imaging device according to one of the preceding Claims, characterized in that printed circuit traces are applied lithographically to the carrier bases bearing the photodetectors for supplying voltage and for diverting the signals.

12. The video imaging device according to one of the preceding Claims,

characterized by a video screen designed for a dual function, in particular a color video screen.

13. The video imaging device according to Claim 12, characterized in that provision is made for a hollow space to be arranged between the carrier base (21) forming the focusing elements (22) and the carrier base (25) for the photodetectors (28), for luminescent surface elements (24) to be applied to the inner side of the carrier base (21) for the focusing elements (22), and for controllable electron sources (26, 27) to be configured on the carrier base (25) for the photodetectors (28), each of the electron sources being assigned to a luminescent surface element (24).

14. The video imaging device according to Claim 12, characterized in that an additional carrier base (32) for luminescent surface elements (24) of the video screen rests on the carrier base (31) for the focusing elements (22), and that an additional carrier base (34) for the controllable electron sources (26, 27) is provided parallel to the carrier base (33) for the photodetectors (28).

15. The video imaging device according to one of Claims 13 or 14, characterized in that the controllable electron sources (26, 27) are constituted, as the case may be, by at least one emitter tip (26) and by extractor wires (27).

16. The video imaging device according to Claim 15, characterized in that the emitter tips (26) and the extractor wires (27) are produced by means of corpuscular beam-induced deposition.

17. The video imaging device according to one of Claims 12 through 16, characterized in that the electron sources (26, 27) and the photodetectors (28) are able to be operated in time-division multiplexing mode.

Abstract of the Disclosure

In a video imaging device having at least one photodetector per picture element to be recorded, a focusing element for forming an image of one picture element at a time on the at least one photodetector is arranged in front of the at least one photodetector. A video screen designed for a dual function, in particular a color video screen, is likewise possible, a single surface being used for recording and reproduction.

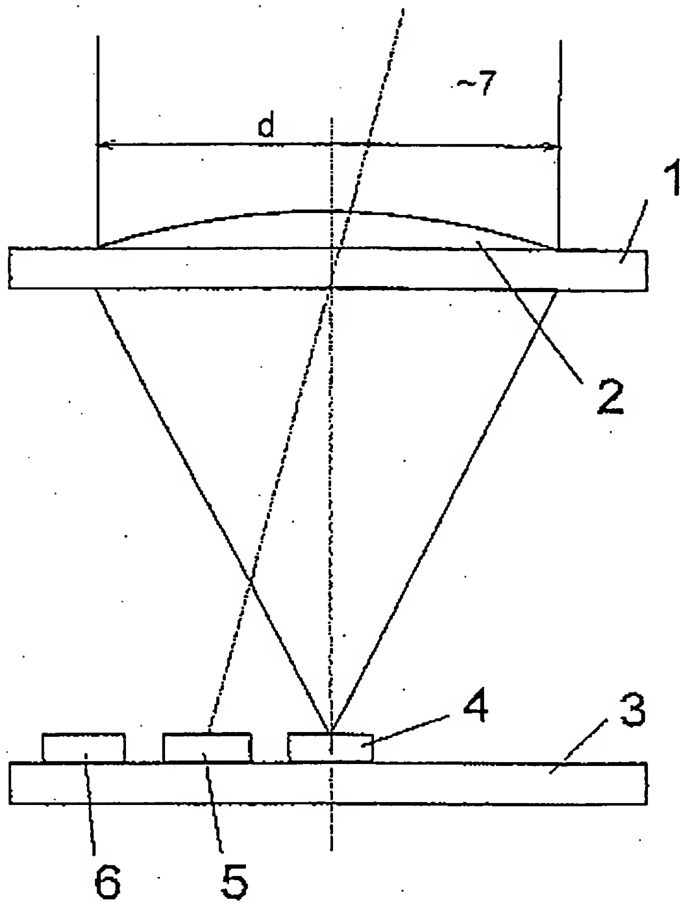


Fig. 1

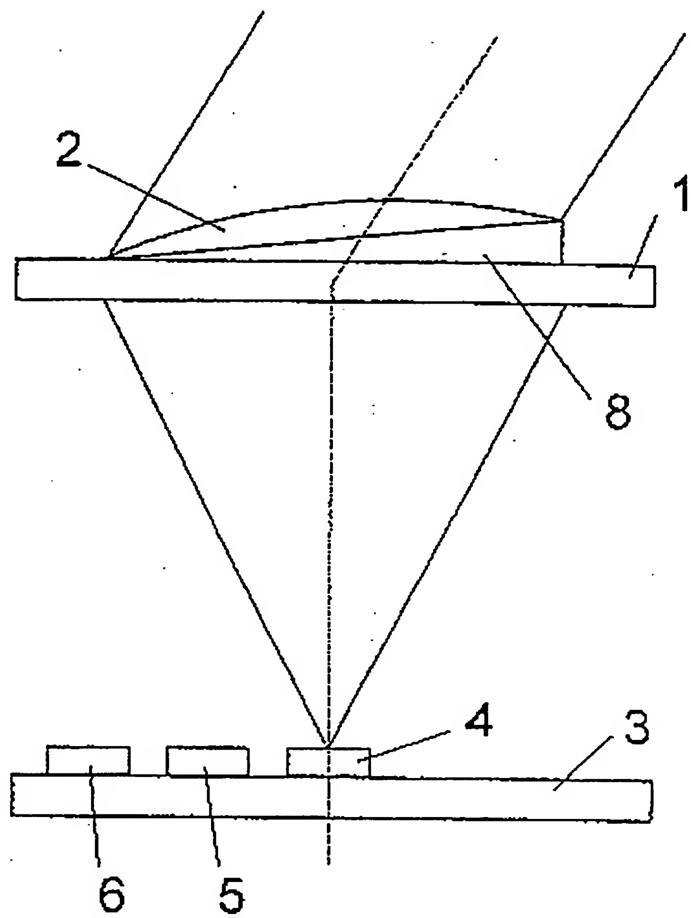


Fig. 2

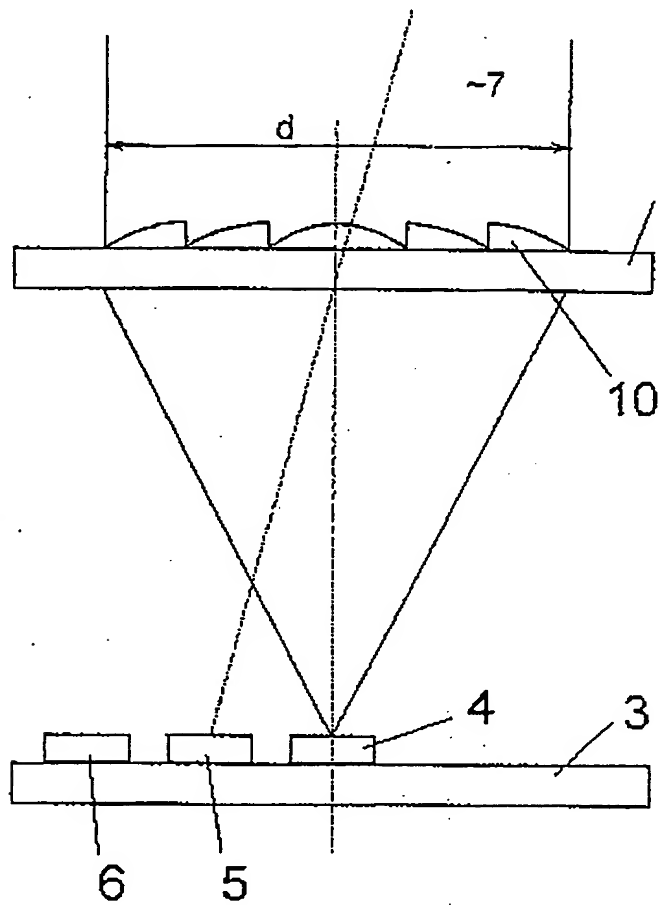


Fig. 3

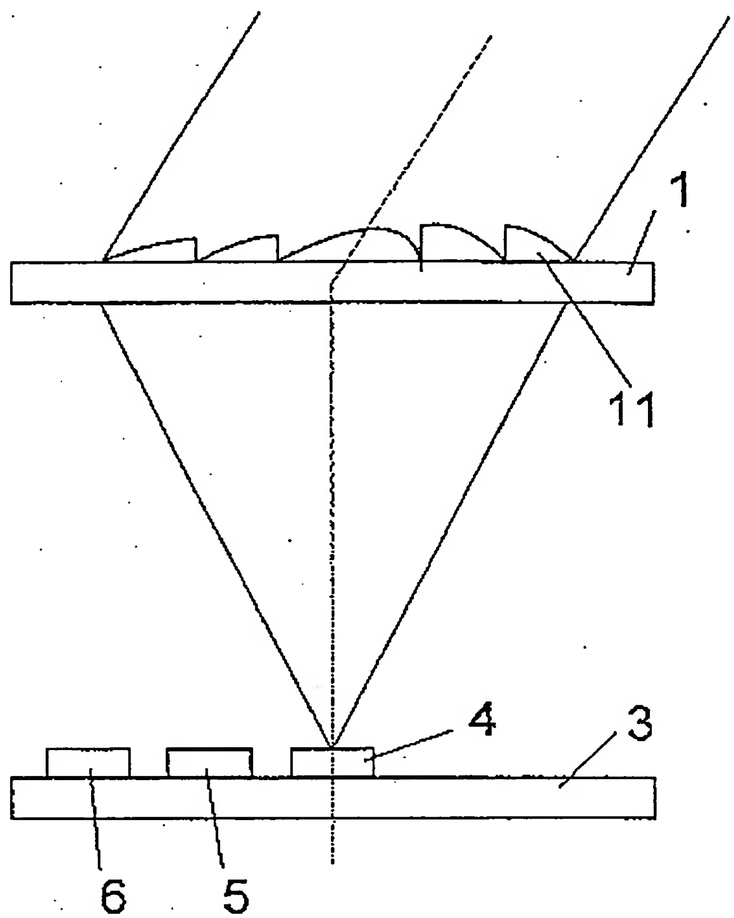


Fig. 4

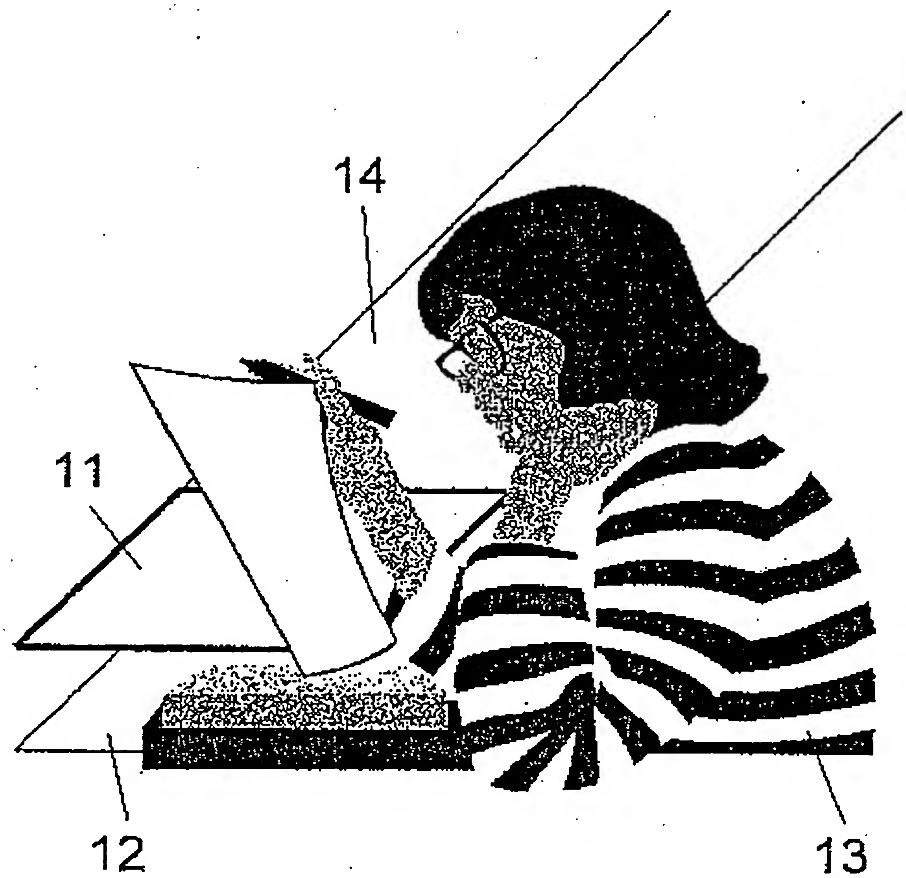


Fig. 5

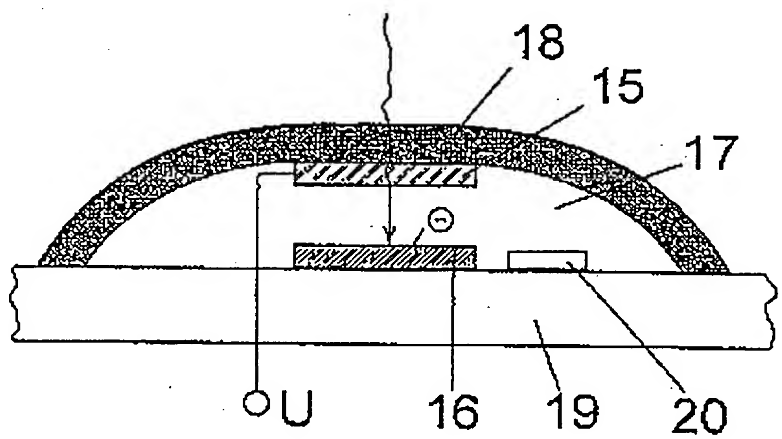


Fig. 6

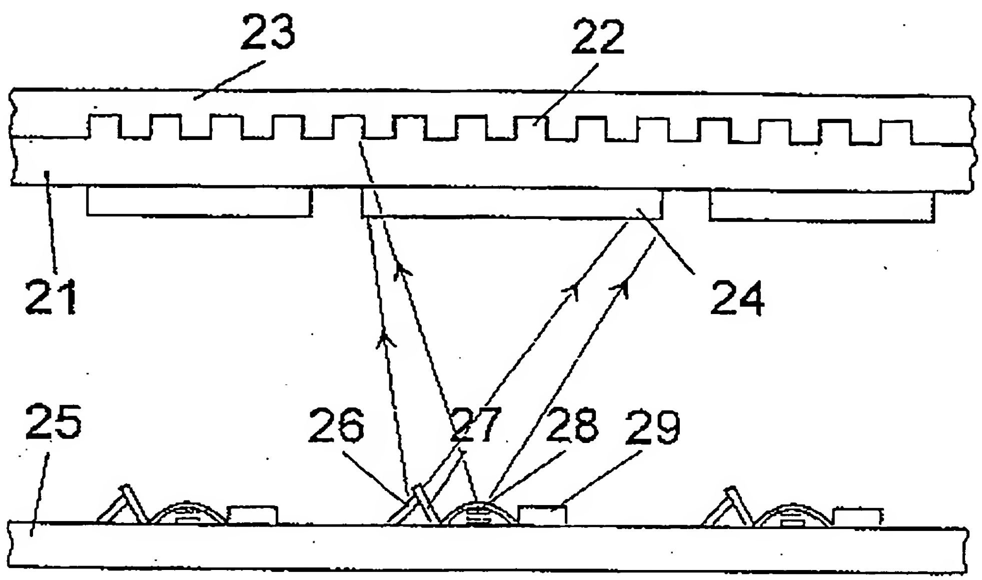


Fig. 7

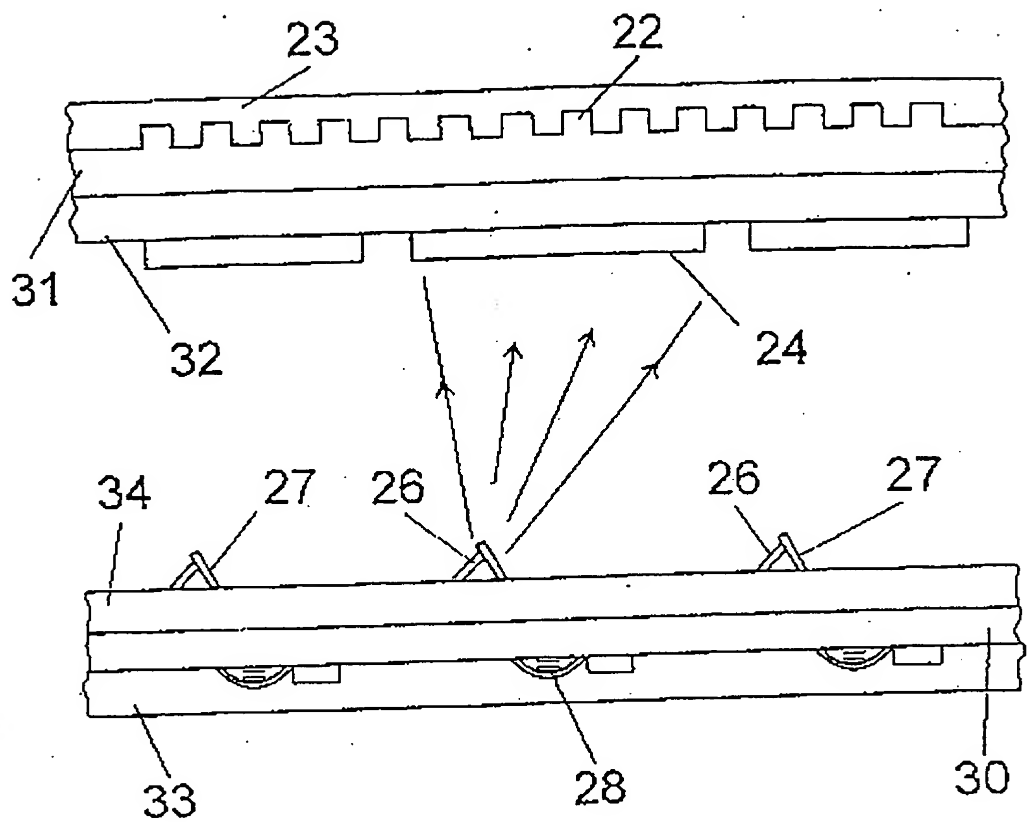
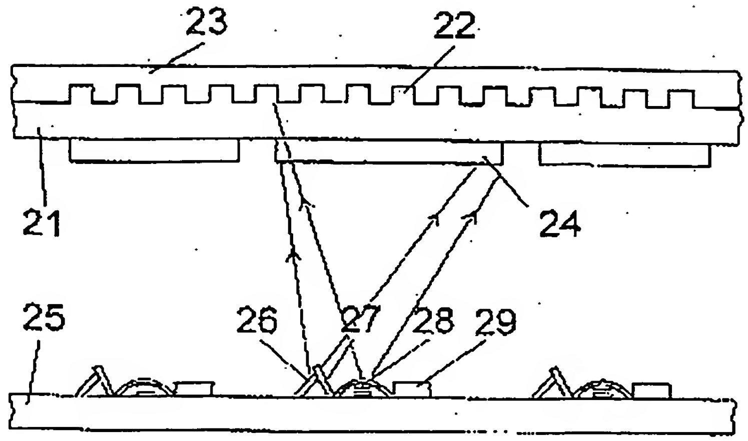


Fig. 8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